Helping Massachusetts Municipalities Create a Cleaner Energy Future

COMMONWEALTH OF MASSACHUSETTS

Charles D. Baker, Governor
Matthew Beaton, Secretary
Judith Judson, Commissioner

LED Street Lighting Webinar

Kevin F. Galligan, Galligan Energy Consulting Inc.

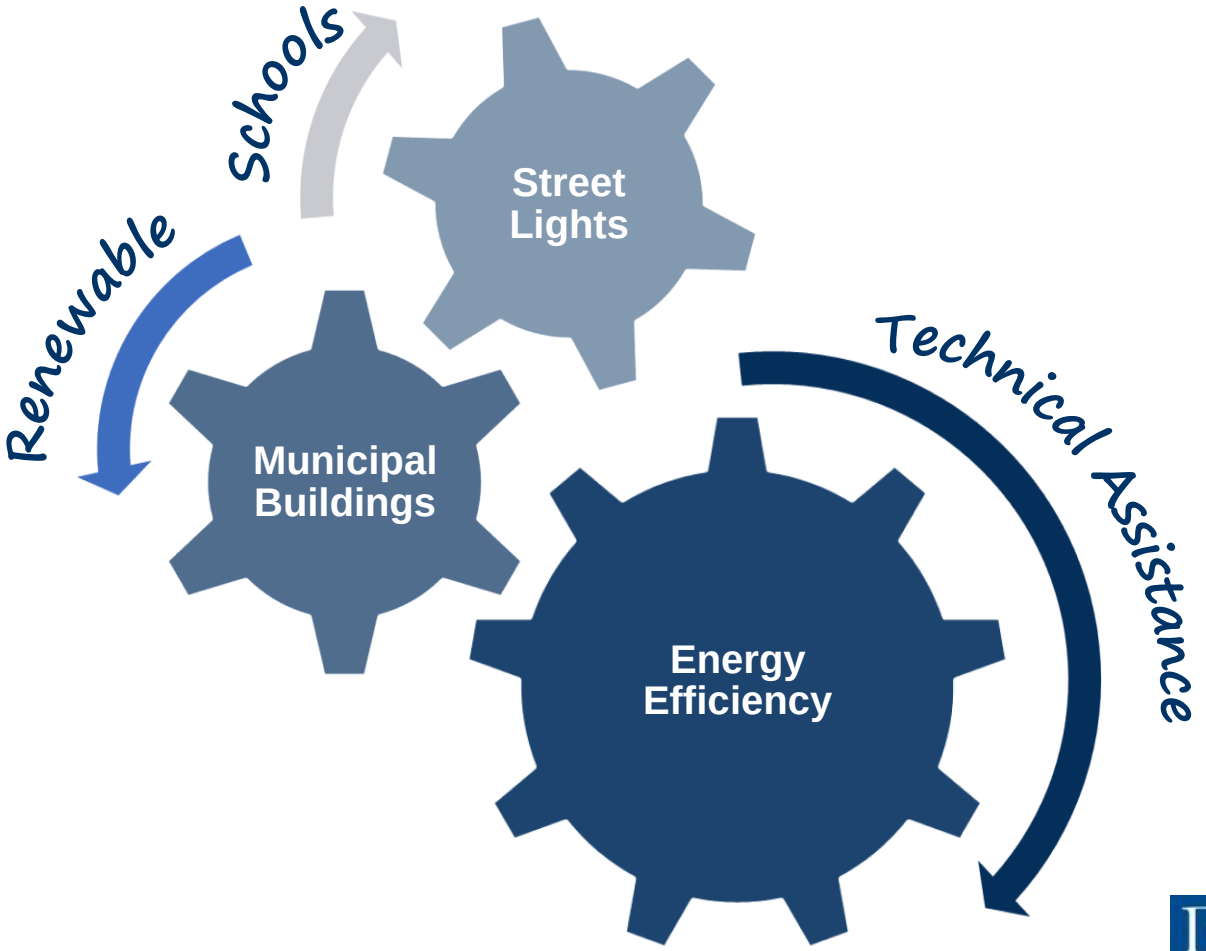
Webinar

May 29, 2015

12:30 PM

Green Communities Division

The energy hub for ***all*** Massachusetts cities and towns, not just designated “Green Communities.”



Helping Massachusetts Municipalities Create A Cleaner Energy Future

Outreach - Regional Coordinators

- Regional Coordinators act as direct liaisons with cities and towns on energy efficiency and renewable energy activities
- Located at each of the DEP Regional Offices:

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Green Communities Division -
Programs & Resources for Municipalities

- Green Communities Designation and Grant Program
- MassEnergyInsight energy tracking and analysis tool
- Municipal Energy Efficiency Program
- Energy Management Services Technical Assistance
- Clean Energy Results Program (CERP)
- Mass Municipal Energy Group (MMEG)
- Website filled with tools & resources: www.mass.gov/energy/greencommunities

Email updates via e-blasts – Sign up by sending an email to:

join-ene-greencommunities@listserv.state.ma.us

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Recording & Presentation

- The webinar is being recorded and will be available on our website in approximately 48 hours at: http://www.mass.gov/eea/energy-utilities-clean-tech/webinars.html
- Click on the camera icon top right of your screen to save any slides for future reference
- Use the Q & A icon on your screen to type in questions
- The slide presentation will also be posted at: http://www.mass.gov/eea/energy-utilities-clean-tech/webinars.html
- Websites are also listed at end of presentation

Agenda

- Background and assumptions
- Technology, Specs, & Standards
- Cape Light Retrofit Project
  - Working with 23 municipal program participants
  - Demonstration/pilot phase
  - Procurement
  - Product selection
  - Costs, benefits, and results
- Some lessons learned & ideas for the future
- Appendix: Helpful references

Background and Assumptions

- This retrofit project converted all eligible municipal-owned streetlights to LEDS among 23 participating municipalities on Cape Cod & Martha's Vineyard
- Cost-effective measure fully funded as part of a multi-year energy efficiency project administered by Cape Light Compact
- One Energy Management Services (EMS) agreement
- Individual participation agreements with each municipality
- Inventory & street light utility billing process described here is specific to Eversource (formerly NSTAR Electric)

Technology, Specs & Standards

- Trend continues to lower cost of LED roadway luminaires
- Efficacy (efficiency) continues to improve (lm/w)
- Educate, learn & share (see appendix for helpful references)
  - Roadway Lighting specifications are well established and continue to evolve based on improvement in technology
  - Not all roadway lighting was designed/installed with any specs in mind
    - Some older mercury vapor and sodium fixtures may go back to 1960's
    - Some more oriented to pedestrian vs. roadway application

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Cape Light Compact Retrofit Project

OVERALL TOTALS

- 23 participating municipalities
- 15,700* eligible lights converted (projected 12/31/2014)
- 17,000 points GIS GPS-mapped
- Annual energy savings > 3,310,000 kWh (approx. 70% reduction)
  - Annual utility bill savings > $657,000
  - Annual maintenance savings> $212,000
- Combined annual billing and maintenance savings > $869,000

Energy Efficiency Program Funding by Cape Light Compact

- Approx. $5.9 million (incl. GIS GPS-audit), part of 2013-2015 Three Year DPU Approved Energy Efficiency Plan
- 10-year energy savings performance contract (Ch. 25A)

*Eligible lights were municipal owned-roadway street lights (NSTAR S-2 tariff (Rate Code 82))

Cape Light Compact Project Highlights

- Multi-year, multi-phase, effort from early 2012-2014
  - Demonstration project led to 6-phase full conversion project
  - Mostly non-summer work, 60-day adjustment period
  - Special terms & conditions unique to many communities
  - Provided for purchase from NSTAR for Phase II participation
- Special recognition
  - Falmouth – greatest # of streetlights (2,573, not incl. admiral hats)
  - West Tisbury – greatest % energy savings (87%)
  - Provincetown most engaged community in demonstration phase
- Thanks and appreciation
  - CLC board members and staff, DOER, DPU, NSTAR, Town Administrators, DPW/HWY staff, selectman, and all involved

Cape Light Compact Project Benefits

Project Benefits

- Significant increase over planned estimates
- Combined total savings

	Annual Estimated kWh Savings	Annual Estimated Utility Bill Savings	Annual Estimated Maintenance Savings
January, 2014	3,170,904	$652,441	$210,398
September, 2014	**3,309,419**	**$656,912**	**$211,561**
(Peak Demand Reduction = 0.827 MW)			

**Savings estimate revised based on “as installed” actuals and the addition of additional Phase II participants including:

C-O-MM, Tisbury and West Tisbury who completed their purchase of street lights from NSTAR Electric

Poll Question #1

- What is the stage of LED street lights in your community?
  A. Already installed
  B. Procurement or installation in process
  C. Pilot, inventory or research
  D. Don’t own, not started, don’t know

Special Considerations

- Admiral Hats (324 fixtures) retained (1960's vintage)
  - Incandescents/CFLs replaced with screw-in LEDs (including feeder wire replacements to extend life of fixtures)

- Floods & decoratives included in final Phase 6
  - Subject to cost-effectiveness screening
  - Only for outdoor roadway/parking area-type fixtures

Cape Light Compact Project Schedule

- Demonstration/pilot project (8 LED fixtures/community)
- Gathered DPW Directors & community feedback (survey)
- Set Schedule in early 2013 for Full Conversion Project:
  - June 14: Participation Agreements Executed
    - Including Special terms and Conditions beyond standard specs
  - July 12: RFP Issued
  - July 26: Bidder Questions/Pre-Bid Meeting/Field Site Visits
  - August 9: Proposals Due
  - Aug 16: Bidder Presentations
  - Sept 6: Award (Contracts executed by Oct 4)
  - Oct 4: Project Kick-off
  - Nov 1: Pre-install field assessments (investment grad GIS GPS-based audits)
  - Nov 15: Fixture orders placed
  - Jan, 2014: Installations begin (batching billing updates town-by-town)
  - June, 2014: Installations complete
  - November, 2014: Fixture revisions (if needed)
  - December, 2014: Final invoices and wrap-up

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Full Project Scope
Fixture Selection

- Competitive Procurement (RFQ per M.G.L. Ch. 25A, Sec. 11I)
  - A Guaranteed Energy Savings Contract (IGA (Audit) &EMS)

- Cape Light Compact contract on behalf of participants:
  - New LED fixtures replace existing operating fixtures
  - New LED fixtures replace comparable, or lower, lumen size
  - Retrofit all municipal-owned streetlights to LED
  - Pre-installation energy assessment/audit
  - Fixture selection/procurement
  - Fixture installation
  - 100% Cape Light Compact energy efficiency program incentive for Project (**except any police detail)** subject to cost-effectiveness screening

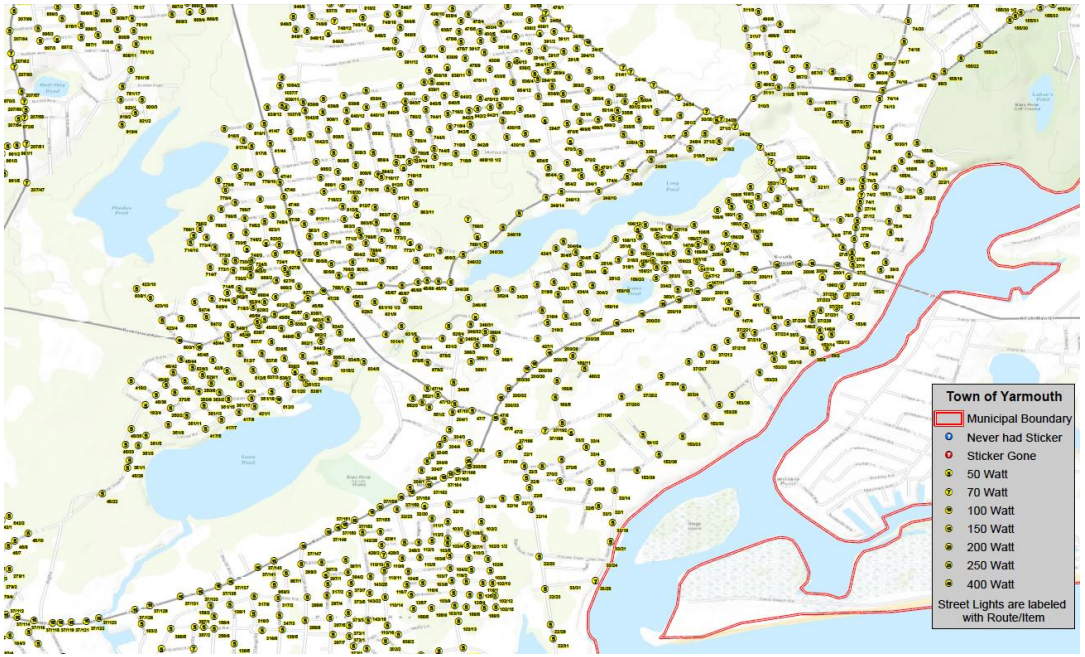
Full Project Scope Cnt'd
Operations and Maintenance

- Participating Municipality will have separate contract for O&M services:
  - General Maintenance Fixed Price per lamp/mo
    - Contractor does visual inspections "spotting" OR
    - Community (Town/FD) does "spotting"
      - Considering request for web-based app to submit outage reports
- For additional fixture changes to LED (after Retrofit Project)
- Call Center
- Emergency response
- Extra work
- Response times
  - Repairs done not more than five business days from outage report

Fixture Selection and GIS Mapping

Primary Fixture Selected

GIS Mapping (example section of Yarmouth)



Cree Beta LED XSP Series
hEp://www.cree.com/lighBng/products/outdoor/streetlights/xsp---series---streetlight

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Fixture Selection Cnt'd

Fixture Choice

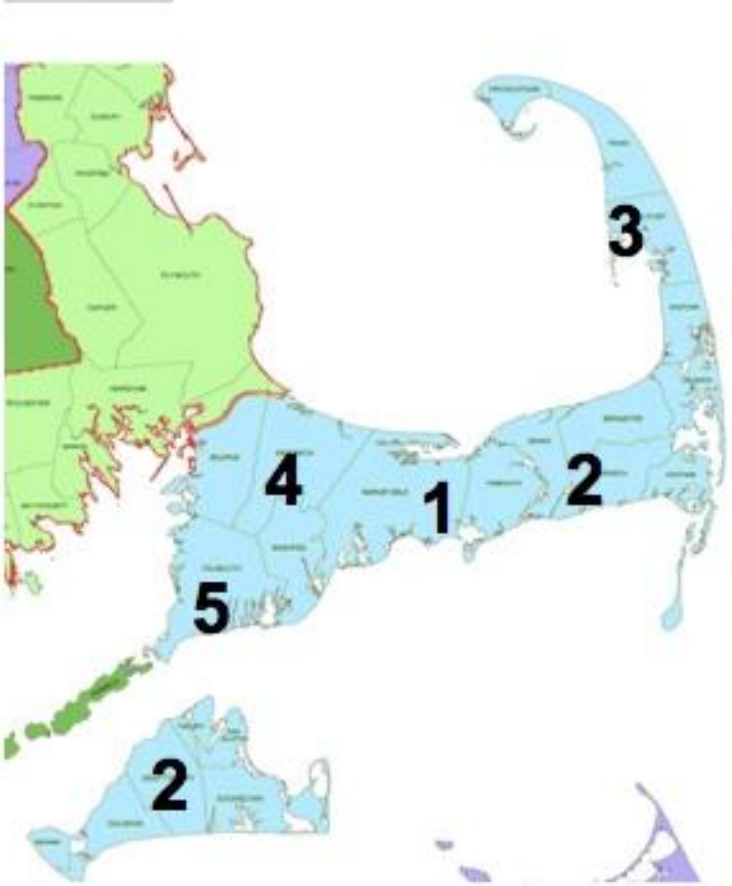
- Evaluated performance, features and costs of multiple manufacturers
- Selected Cree Beta XSP 1 series fixture
  - Similar cobra head design to old HPS figures
  - Warmer color temperature CCT: 4000 K (+/- 300K)
  - Highest energy efficiency (70% savings over HPS)
  - Optical and lumen controls
    - Field installed shields
    - Field adjustable (lumen) output

Cree Beta LED XSP Series
hEp://www.cree.com/lighBng/products/outdoor/streetlights/xsp---series---streetlight

Poll Question #2

- What is the primary barrier to your community's LED street light retrofit?
  A. Don't own the street lights
  B. Financial
  C. Technical assistance and/or project management
  D. Community support
  E. Other (please enter in comments)

Ultimate Schedule used a Phased Approach



Phase	Locations
1	Hyannis, Yarmouth
2	Dennis, Harwich, Martha's Vineyard
3	Chatham, Brewster, Orleans, Wellfleet, Truro, Provincetown
4	Barnstable, W. Barnstable, Cotuit, Mashpee, Bourne, Sandwich
5	Falmouth

*Status within phase tracked: Field audit, eng/design, report, fixtures ordered, installation, billing revisions, EM&V, close-out

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Web-based app – Track Feedback

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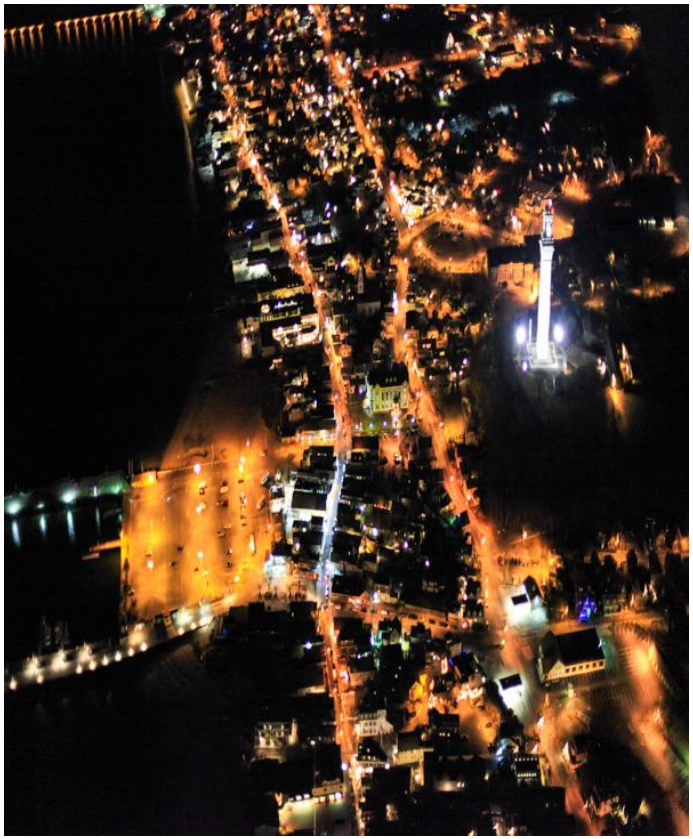
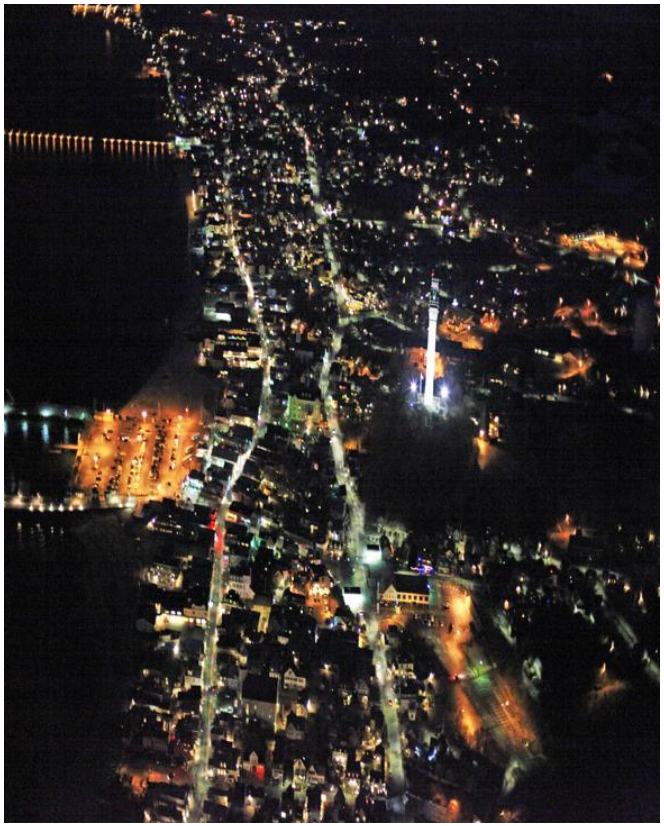
Provincetown Aerial Views

Before (high pressure sodium)



After (LED)



Billing Revisions & Annual M&V

Billing Revisions

- Submitted to NSTAR by Contractor on Town-wide basis
- NSTAR typically implemented revised billing codes within 1 to 2 billing cycles following batches submittal by Siemens

Annual Measurement & Verification (per Chap. 25A, Sec11I)

- Contractor will request by October each year a copy of billing detail from each Participant and submit energy savings performance report to Cape Light Compact
- The Compact then submits Annual Report to DOER (for 10-years)

Some Ideas for the Future

- Looking ahead to grid modernization and time-varying rates
- Consider fixture specs that include capacity for adaptive control and remote monitoring
- With verifiable EMS additional energy savings and life extension of fixtures may be possible

K Option Occupancy Control

For use with XSP1™ and XSP2™

Description:
The Cree occupancy control option allows multiple operating input power options for high and low modes. These input power mutliplers are conveniently selected to balance LED life, lumen output and energy savings. Occupancy control options are designed to have integrated and remotely located sensors. Occupancy control function is designed with all LEDs operating at the same input power for maximum and uniform LED life.

The occupancy sensor used in the Cree K option uses passive infrared technology that reacts to changes in infrared energy (moving heat) within the coverage area. During operation if motion is detected within the sensor's coverage area, the relay in the sensor closes and the lighting load is automatically turned on. When motion is no longer detected for the duration of the time settings, the relay opens and the lighting load is turned off, or set to low level depending on the settings of the sensor. The occupancy sensor includes independent field adjustable settings for Ambient Light, Time Delay, High and Low Dimming.

The Ambient Light feature (A) is factory set at "disabled" which eliminates any daylight harvesting management and allows the fixture to operate only on occupancy. The Ambient Light feature has eight possible settings and can be adjusted from 20–1900 Lux (2–175FC). When activated, the Ambient Light feature will only prevent the lights from turning on or going into high mode (depending on the setting of the sensor) when ambient light exceeds the selected level. In the event occupancy switches a luminaire to high mode and shortly thereafter ambient light levels increase above the selected ambient level, the unit will not immediately return to low mode, rather it must complete the set time cycle (Time Delay Feature) prior to returning to low mode. Settings will vary based on application. Please be aware that light from different sources may disrupt the ambient light feature. Testing and adjusting the Ambient Light feature is recommended before adjusting settings for all other installed luminaires for the specific application.

The Time Delay feature (D) can be adjusted from 0.5 minutes to 30 minutes and is factory set at 4 minutes. Once motion is detected, the lighting load will remain unchanged until the set time cycle is completed.

The Low Dimming feature (L) can be adjusted from an off position to a maximum input power of 41%. This feature is factory set at 23%.

The High Dimming feature (H) can be adjusted from a 46% input power to a maximum input power of 100% and is factory set at 100%.

ture

Poll Question #3

- How controls-ready are your LED street lights?
  A. Have or installing controls
  B. Have or installing 7 pin lights
  C. Not started
  D. Don't know

Lessons Learned

1. Publish the call center number and website for the project, communicate and respond promptly to all requests
   - See Project Task matrix in Appendix
2. Use, share and post on website updated FAQs
3. Hold periodic (during high production, weekly) check-in calls with contractor
4. Frequent site visits, night time QA/QC confirms compliance with Ts and Cs and contractor can quickly respond to concerns
5. Look for more energy efficiency opportunities that may be within scope or outside of scope (and have script to get those additional customer measures served)

Links

- U.S. DOE Municipal Solid-State Street Lighting Consortium
  http://energy.gov/eere/ssl/doe-municipal-solid-state-street-lighting-consortium

- MA DOER Energy Management Services
  http://www.mass.gov/eea/energy-utilities-clean-tech/green-communities/ems.htm

- Metropolitan Area Planning Council
  http://www.mapc.org/led-street-lighting

- Cape Light Compact – Energy Efficiency for Municipalities
  http://www.capelightcompact.org/energy-efficiency/municipal/

- Statewide Contract for LED Roadway/Streetlight Purchases: FAC76, Category 6
  https://www.commbuys.com/bso/

Thank You

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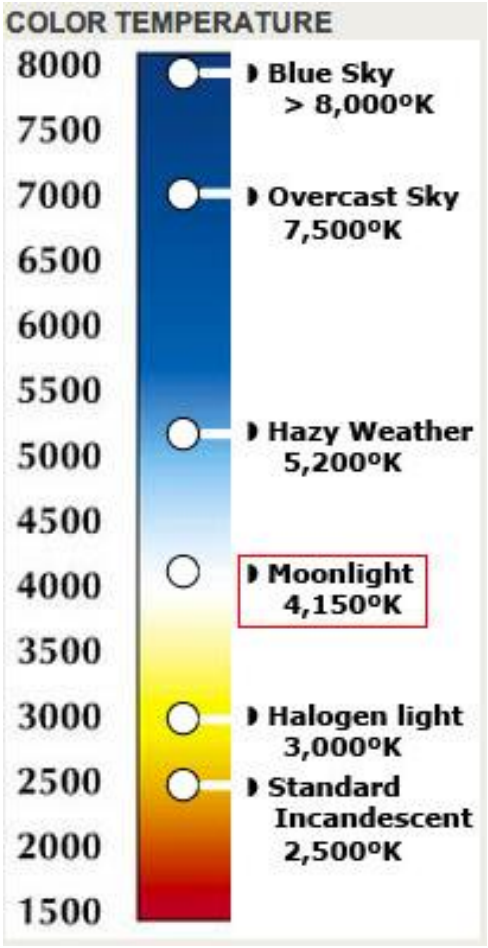
Appendix: Helpful References

Luminaire Performance Metrics

- Light output measured as lumens (lm)
  - The higher the number, the more light is emitted
- Measured input power (watts (W))
  - The higher the number, the less energy used
- Luminaire efficacy (lumens per watt (lpw))
  - The higher the number, the more efficient the product
- Correlated color temperature (CCT) sometimes simply referred to as color temperature is measures in degrees Kelvin (K)
  - "Cool" colors have higher color temperatures (3600-5500K)
  - "Warm" colors have lower color temperatures (2700-3500K)
  - A full moon has a color temperature of about 4150 K
  - **A high pressure sodium street light has a color temperature of about 2000 K**
- Color rendering index (CRI)
  - The higher the CRI, the more accurate the color of illuminated objects appear under the luminaire
    - Natural sunlight = 100 CRI
    - LED light source = 70 – 75 CRI
    - High pressure sodium light source < 25 CRI



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Project Task Matrix

Project Task	Funded by	Contract
Audit of existing fixtures	Cape Light Compact	Investment Grade Audit (IGA)
Design of new LED system	Cape Light Compact	Energy Management Services (EMS)
Supply & install new LED fixtures	Cape Light Compact	Energy Management Services (EMS)
Make adjustments as requested within 60 days post completion	Cape Light Compact	Energy Management Services (EMS)
Repair outages, day burners	Member communities	Operations & Maintenance (O&M)
Emergency repairs due to vehicle or weather damage	Member communities	Operations & Maintenance (O&M)
Pole transfers	Member communities	Operations & Maintenance (O&M)
Police details	Member communities	Operations & Maintenance (O&M)
Electrical troubleshooting, misc. work as requested, addition, removal, or modification of LED fixtures	Member communities	Operations & Maintenance (O&M)

Example Retrofit Comparison 100 W HPS to 26 W LED

	Watts	Lumens*	lm/w	Est'd Annual Energy Savings (kWh)	Est'd Annual Energy Savings ($)**
100 W HPS	121	9,500	56		
LED XSP1 (G)	26	2,543	95	377	$75

*Lumen differences between HPS and LED exist for multiple reasons, including the directional illumination pattern of LED vs. HPS

**Est'd Annual Energy Savings assumes $0.20/kWh

Operations & Maintenance

- O&M contract in place with each Town or Fire District & Siemens
- Contract term: 3 years
  - Option to extend for 2 years
- Outage reporting call Siemens at 800-544-4876 (800-LIGHTS-ON)
- 5 business day response

O&M Contract Comparison (Maintenance Pricing - $ Per Light Per Month)		
	non-LED fixture	LED fixture
Old O&M contract	$1.22	n/a
New O&M contract	$1.27	$0.33
>70% lower fixture maintenance pricing with LED vs. non-LED		